**RETURN TO VERNACULAR ORIGINS
THROUGH PARAMETRIC INTERPRETATION**

By Yunjing Zhang

Thesis Supervisor: Marc Aurel Schnabel

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The work presented in this thesis is the result of numerous discussion, iteration, dead ends and failure. It would not even be figured out without the support and help of those around me.

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ABSTRACT

Without any doubts, China has made a remarkable development in various fields in a last decade, and there are no any signs of that the paces of rapid development happened to China will slow down in the next decades. As a result, every city in China are entering into a boom period in term of urbanization and modernization. No matter it is a super metropolis, for instant, Shanghai, Beijing or it is a small city as Yangzhou, the one chosen for this research thesis, they are all a part of this rapid booming trending and progress. Parametric architecture has been playing a significant role in this booming period: avant-garde forms, incredibly large scale, starchitect such as Zaha Hadid, Rem Koolhaas etc, and extra economic value added, all these features had made parametric architecture to be considered as the symbol of the rapid development. At same time, the voice of critical on this has never stopped: lack of traditions, absence of “Chineseness”, cities identity damaged caused by parametric architecture. Unfortunately, there seems neither nothing going to stop numerous parametric architecture raised up, nor provide a convincible solution to the issues in the contemporary cites in China.

This thesis explores the conflict between Chinese vernacular manner and parametric architecture, and investigate how the parametric architecture is able to well fit in the Chinese environment context and express Chinese vernacular ideas which needs to be redefined.

It argues the so called ‘Chineseness’ is blur and unclear, or most of people ‘s understanding toward ‘Chineseness’ always stay at the iconic level. It further argue the essences of Chinese vernacular ideas which could be merged into parametric architecture and help to deal with the issues which the contemporary city in China has such as inhumanity scale, lack of green space and public space. The aim is not only to find a way to combine the parametric design and Chinese vernacular ideas harmoniously but also via this combination to solve the issues in Yangzhou which is a representative and typical China contemporary city.

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Shanghai Skyline ----- Josef Hoflehner, 2008, Shanghai, China

1.0 INTRODUCTION

- Problem Statement
- Scope and Proposition
- Methodology

PROBLEM STATEMENT

China is undergoing a dramatic transformation based on brutal economic development. Every city in China are entering into a boom period in term of urbanization and modernization, numerous high rise buildings are raised up so quick which keeps changing the skyline of cities in China. So far there are 886 skyscrapers in China, the most in the world, more than that 822 in US, 173 in Japan (Fig 1.1).

However Wang Shu advocates that the prosperity created by numerous high rise buildings and rapid modernization is an illusion of development. The price for this illusion is losing identity of the cities, nation even culture (Xinhua News Agency, 2012). Furthermore, the

opinions of European and American critics say what is occurring in China is a progress what had already occurred in Europe and the USA: Shanghai, Beijing will be another New York and London on oriental continent. And all issues used to happen in New York, London would appear in China due to the globalization and modernization. One of the most significant issues is, as mentioned above, loss of cultural identity. In fact, it is necessary to highlight the U.S.'s own lengthy tradition of copying European architectural prototypes, from Italian palazzos to English gothic designs, and then until now the International Style is dominating the architectural design all over the world. However, it appears reasonable for United States' cities to

Fig 1.1

SCOPE & PROPOSITION

draw from on the architectural styles of peoples who share the same geo-cultural genealogy, heritage and ideology. But for a complete different culture and people, such as China, pulling from a geopolitically, temporally, and culturally alien architectural background appears to have no supporting or convincing reasons to do so. As a result, the disconnection between contemporary architecture in China and local culture is obvious. Moreover, it is becoming an obstacle and its own victim of its success in the development of China's own contemporary architectural identity. Hereby current parametric architectural designs in China contribute to accelerate the detachment rather than to offer solutions or potential opportunities to define a contemporary Chinese architectural identity.

The fact remains that each time a new construction technology is developed, new architectural styles and movements will naturally appear. Since emerging computational design and manufacturing techniques have entered the field of architecture, parametric architecture is developed further and more popular although this kind of architectural approach was never a new thing.

'Parametricism' was claimed as "A New Global Style for Architecture and Urban Design" by Patrick Schumacher (2009), he believed parametricism is the next big epochal style in architecture all around the world. In fact, it has been becoming the dominant style for plenty iconic buildings in recent years. Especially in China, it is not only due to the modernism and globalization trend, but also due to demands of representation of a nation. However, the parametric architecture has failed to preserve the traditional and distinct appearance of local architectures resulting in a disconnection from the surrounding environments and cultural identities. Schumacher (2014) responds to this by saying: "If you like, but this distinction between east and west is meaningless now, because all of these societies are now fusing into world society, into a single global civilization with a global architecture". It seems an exaggeration, but what are happening in China now: many parametric design buildings in China such as Galaxy SOHO, Guangzhou

Fig 1.2

Top left is Galaxy Soho, top right is Phoenix International Media Center, the bottom is Guangzhou opera house

Opera House, Phoenix International Media Center, (Fig 1.2) are actually indicating ‘fusing’ progressing. It is also the reason why critics are always criticize parametric architecture about the absence of ‘Chineseness’. In addition, due to irregular forms parametric architecture has often been related to high budget costs, difficult constructions and other issues. But it is not true, these judgment about parametric architecture it leads to does no base on facts but prejudice or a certain manner of thinking.

This thesis argues that parametricism is able to and needs to return to a vernacular, tradition, and heritage that is accessible and responsive to the local environment, its people, culture and local identity, while at the same time make advantage of the capabilities of parametric designing that includes dynamic, complexity and rule-based systems. It is necessary to explore the essences of Chinese vernacular ideas in terms of architectural origin rather than in term of historical and political environment. Because social and political structure is completely

METHODOLOGY

different, what ancestors used to do for living or what manners they had are barely relevant and inherited in modern times. But there is still a beauty of vernacular and tradition that people are admiring nowadays, which is beyond the forms, constructions, technologies, all those physical levels. Making sure the research of Chinese vernacular ideas is not staying at iconic level such as 'Dougong' (interlocking wooden brackets), 'Siheyuan' (Chinese courtyard house), which is the scope of the thesis. At same time, misunderstanding about the parametric architecture is necessary to be clarified due to the some bad examples built in China. The thesis argues further the misunderstanding is not only caused by improper parametric approach used without considering the vernacular ideas but also confliction of Chinese vernacular design approach and parametric design approach. The aim of thesis is try to exact Chinese vernacular ideas which is inherited and still existing in people's life nowadays in order to be combined with parametric architecture.

Obviously, there are two lines simultaneously going through the theoretical study based on Chinese vernacular architectural ideas and parametric architecture separately, which the literature and project review are organized with. It leads to a proper way and general approach to interpret Chinese vernacular ideas through parametric design. Site analysis is necessary to reflect the certain issues in Yangzhou city which the design outcome can undertake and solve. These are followed by a preliminary design which is comprised of various parametric designing methods. The relevant data is established, simulated and testing based on reality in order to find the most optimized solution. The evaluation process later leads to the diagrams. The stage of developed design is undertaken to enable the design outcome well fitting in Yangzhou city. The thesis ends up with conclusion and critical reflection. The entire thesis structure has been organized as the diagram shown next page (Fig 1.3).

Fig 1.3
Methodology Diagram

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VIEW

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J E C T
I E W

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ai Natural History Museum
ngzhou Opera House

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P R E L I M I N A R Y
D E S I G N

Shan Shui City Concept

Setting criteria
Evaluation
Optimizing process

Prototype Design
Optimized path system based on
Frei Otto's study on wool threads system

Algorithms study
Interactive forces introduced

D E V E L O P E D
D E S I G N

Mapping and diagram

Analysis the path system
applied on site

Modelling

C O N C L U S I O N
&
R E F L E C T I O N

Critical reflection
Limitation
Future potential development

Some reality situations are more complicated not concerned

Chongqing Skyline ----- Josef Hoflehner, 2009, Chongqing, China

2.0 LITERATURE REVIEW

- Definition of Parametric Architecture
- Digital/ Computational Architecture versus Parametric Architecture
- Chinese Vernacular Architecture versus Parametric Architecture
- Shanshui City

DEFINITION OF PARAMETRIC ARCHITECTURE

“Many people have misgivings about the term parametric.” Neil Leach claims, “few people in the West working at the forefront of computation use the term parametric or parametricism, although it is still popular in China for some reasons.” (Neil Leach and Schumacher 2012) There is a possible reason: China is among the few countries which are able to build many impressive parametric architecture practices. But as an exotic term parametric has never been clearly explained and understood systematically and comprehensively in China. The term parametric is wrongly and popularly becoming the definition of approach for designing free form building. So before looking for a proper approach to combine parametric architecture and Chinese vernacular ideas, it is necessary to clarify what parametric architecture is and what Chinese vernacular ideas are. Whilst dilemmatic circumstance about parametric architecture in China also needs to be explored for a more comprehensive thinking about how to combine via projects review.

The term parametric originates in mathematics without question and it was firstly used in the 1940s’ writings of architect Luigi Moretti (Bucci and Mulazzani 2000,21). Moretti (1971,207) defines “parametric architecture” as the study of architecture systems with the goal of “defining the relationships between the dimensions dependent upon the various parameters.” He uses

the design of a stadium (Fig 2.1) as an example to explain how the stadium can be formed by nineteen parameters such as viewing angles and the cost of concrete (Moretti 1971,207). Between 1960 and 1965, Moretti designed the Watergate Complex which is “believed to be the first major construction job to make significant use of computers” (Livingston 2002). It is difficult to find whether there is a connection between parametric design and computer in the Watergate Complex at that time. But it is reasonable to consider Moretti as a pioneer architect in parametric architecture.

Fig 2.1
The stadium designed by Luigi Moretti based on a parametric model consisting 19 parameters.

Antoni Gaudí and Frei Otto were using the physical parametric models to derive their design work. Antoni Gaudí used a hanging chain model, which has at least four parameters: its length, its weight, and two anchor points, to generate the form of Colònia Güell in Europe at the turn of the twentieth – century (M. Burry 2011,231). Frei Otto similarly used physical parametric models as a form finding technique beginning in 1950s (Otto and Rasch 1996). Nowadays architects make parametric models with computer and various of software. But it does not mean the computer or other digital tools is the essential component of parametric architecture. Architect have always produced parametric design. Several authors has claimed the similar notion including Robert Aish and Robert Woodbury:

Parametric modeling is not new: building components have been adapted to context for centuries.

Aish and Woodbury 2005, 152

The same argument has been made by David Gerber in his doctoral thesis, Parametric Practices:

It must be stated that architectural design is inherently a 'parametric' process, and that the architect has always operated in a 'parametric fashion'.

Gerber 2007, 54

Roland Hudson starts his doctoral thesis, Strategies for Parametric Design in

Architecture, with the straightforward point:

This thesis begins with the assertion that all design is parametric.

Hudson 2010, 18

Same claim from each of these authors is not coincident, they are sharing the same idea: all design naturally and necessarily involves parameters at first place, the site contexts, materials, programming, budget, social environment, all these factors could be parameters to relate to outcomes through explicit functions or certain relationship. But in the past the whole “parametric design” process only happened in designers’ brains, the correlations between parameters and outcomes are downplayed, which is supposed to be more pivotal than parameters.

DIGITAL/COMPUTATIONAL ARCHITECTURE

VERSUS

PARAMETRIC ARCHITECTURE

As mentioned before, parametric architecture has a long history, obviously longer than that the computational technology entered the field of architecture. The computer seems to be another hand to help architects for the design process, from drawing, simulating, modeling, and rendering. But it is a helping hand and no more than a helping hand. The computer can not make decisions, they are able to produce a basement to help architect for decisions. In this perspective, the term of digital/ computational architecture is defining what tool the architects use to design. It also means there is no certain relationship between digital architecture and parametric architecture, but it is hard to deny the computational technology has raised parametric architecture up to a new level than ever. And it is also the cause of the confusion about parametric architecture and digital/computational architecture in China. For further discussion, there is a diagram next page (Fig 2.2) indicating that digital tools impact deeply the architecture design and manufacturing nowadays based on the my observation and experience when I was working in China. Due to the explosion of digital technologies, the ability to visualize and manufacture also has been massively expanded, which are revealed by the blue parts. On the other hand, in term of design approaches, digital technologies widely broaden the horizon which were limited by the complexity and

nonlinearity of design process. The underlying logic, mathematics and algorithm of nature has been better understood and simulated by computer, which are represented by the red parts in the diagram. Cellular automata, multi-agent system, voronoi and so on, none of them can be established without parameters. In this perspective, they all belong to parametric architecture. But the point is that digital architecture and parametric architecture are completely different, they can not be mixed up. Furthermore, to parametric architecture, the computer is not only playing a role of a neutral tool, but also is a role of shaping the way designers are approaching the question of design.

Fig 2.2

The diagram of digital architecture in China is created based on author's observation and working experience in China.

1* . RULE- BASED NON-COMPUTER AIDED ARCHITECTURE

2* . COMPUTATIONAL FLUID DYNAMICS

3* . BUILDING INFORMATION MODELING

CHINESE VERNACULAR ARCHITECTURE

VERSUS

PARAMETRIC ARCHITECTURE

“Expressing design intentions with parameters and explicit functions requires a different way of thinking than most designers are accustomed to. In addition to thinking about what they are designing, architects working with parametric models must also think about the logical sequence of formulas, parameters, and relationships that explain how to create their designs.” (Aish 2005, 12; Woodbury 2010 24-25). It is quite explicit to point out the shift, happened in parametric design process compared to traditional design approach, from output to “formulas, parameters and relationships”. It refers to the difference between “bottom-up” and “up-bottom” design approach. In other words, parametric design approach is considered as a bottom-up process because the outputs emerges from the relevant constraints rather than blueprints. The advantage is obvious that parametric design approach is a rational process, which means it suited to the problems such as structural, constructional, environmental and economic problems. But architecture always consists of ‘wicked problems’ such as aesthetic, inhabitation, and cultural problems, which Jon Liebman says, “incomplete, contradictory and complex” problems. (Jon Liebman 1976,106). Therefore, apparently, parametric architecture is not appropriate for all architectural problems.

In contrast to parametric architecture, Chinese vernacular architecture always starts with a certain blueprint which the underlying ideas are highly consistent with the essence of Confucianism: strict hierarchy and the essence of Taoism: the relationship between human and nature.(6: See Hu Dongchu, The Way of the Virtuous. The Influence of Art and Philosophy on Chinese Garden Design(Beijing: New World Press, 1991).) As the diagram next page shown (Fig 2.3), the influence of Taoism and Confucianism on architecture design was asserted through poetry, Chinese painting, regulation and Fengshui. The poetry and Chinese painting are normally considered as a concept to express a kind of feeling for calling up emotional reaction to natural scene rather than a descriptive image of nature, which means they determine inner feeling, atmosphere as a fundamental tone for design, whilst set a standard to landscape and to introduce natural elements especially for Chinese gardens.

Forms, layouts, details and orientations are more impacted by Confucianism. As Bianca Maria Rinaldi claims in her book (Bianca Maria Rinaldi,2013, 13-14.) “Confucianism as a group of philosophical doctrines engendered a political ethic rather than a religion..... Confucianism looked at man working in a definite context, in society and within the family.” At that time, it

Fig 2.3
Chinese vernacular architecture

was significant because Confucianism generated a fundamental principle for people as well as hierarchical relation for people to define themselves in society and family which was worth of being always emphasized in people's daily life through architecture. This two philosophical ideas were in the radical juxtaposition: the former proposed a connection with the natural world, the latter established the basic structure of design.

Fengshui is an another factor strongly imposed on design, besides being influenced by Confucianism and Taoism, it actually is comprised of many ideas which originated in ancient China to explain natural phenomena. It will not be further discussed in this thesis, but it

is necessary to be mentioned.

In summery, Chinese vernacular architecture actually was more hidebound and rigid than what people see and think, specially western critics, what they are always expecting to see in modern Chinese architecture has no reasons to exist anymore. Because the major of reasons for design with so called "Chineseness" has been no longer existing. It is not possible and reasonable to bring back the Confucianism as ethical and political ideas leading the design in contemporary China, but how to establish the connection between human and nature through architecture base on recognition of Taoism is really valuable and vernacular. It not only means the green or sustainable

architecture but also architecture
underlying an idealized worldview
developed by Chinese through extended
contact with the natural world.

SHAN SHUI CITY

Fig 2.4

The left one is done by Shen Zhou in Ming Dynasty, 1467.

The middle one is a painting by Wang Hui in Qing Dynasty, 1679.

The right one is drawn by Guo Xi, titled as 'Early Spring' in Northern Song Dynasty, 1020-1090 AD

Ma Yansong as an important Chinese architect had claimed a similar idea as “Shan Shui City” in his book, he argues “architects should delineate a new ideal for the city of the future, to gradually construct an urban environment that embodies both the convenience of the modern city and the ancient Eastern affinity for the natural world.” (Ma Yansong 2014, 73) It precisely points out that an answer we are trying to find for a future Chinese city is buried in the history. “Shan Shui” is comprised of two Chinese words, literally means

mountain (Shan) and water (Shui), but it never could be simply understood as natural elements: mountain and water. The term of Shan Shui generally refers to traditional Chinese landscape painting (fig 2.4), unlike the Western painting which is based on the science emphasized proportion, perspective and realistic depiction of form, the Chinese landscape painting is based on artists’ imagination. The contemporary artist Wucius Wong makes an interesting analogy between the way of Chinese artists using imagination for painting and

digital visualization practice:

Wucius Wong 1991

The Chinese artist prefers to rely on his own imagination, and arranges the elements as though he were building a model. From his mind-heart he selects mountains, which he can then rotate and reshape; directs water to wind as springs, jump as waterfalls, or flow as rivers along folds; and combines these elements in a harmonious orchestration displaying vital breath..... Through acquaintance with the elements, the artist will be able to visualize at will in fabricating his scene. Through understanding of the laws, the artist will position the elements in appropriate positions, directions, and proportions, with transitions, extensions, and overlaps conforming to a definite order..... If he wants to have a waterfall, he does not hesitate to put one with the right shape and length at the right place, and to relate it to adjacent elements.

Obviously, the traditional Chinese Shan Shui painting is never in pursuit of perfection in measuring and rendering the objective “truth” of the nature. As a unique form of art, it does not need to be realistic and accurate for recalling a single natural scene in memory. Because the intended purpose of Shan Shui painting is recalling feeling about relationship between people and nature via ideal and symbolic form. This is the reason why there usually are small people figures in Shan Shui painting (fig 2.5). It leads to a core idea of Taoism that is people and nature interact and complement each other to achieve

Fig 2.5

The Shan Shui painting is always containing people in the painting to imply the relationship.

a state of balance and harmony. This idea not only make a significant impact on poetry and other literary works but also vitally contribute to Chinese garden design: mounds and rockery compositions represent mountain, ponds represents water (lakes, rivers) in the nature, and architectural elements such as pavilions and terraces represent owner's yearn of blending harmoniously into natural world.

In 1990, Qian Xuesen, an scientist playing a pivotal role in the beginning of China modernization process, had suggested to Wu Liangyong, an important Chinese urban planner in his letter: " why do not we design a 'Shui Shan City' based on the concept extracted from Chinese Shan shui painting, Shan Shui poetry and Chinese garden? "(fig 2.6) As a non-architectural background man, Qian Xuesen's idea may not be considered as an rigorous and serious argument as architectural concepts for city development in China at that time, but it is indeed prospective, vernacular, and representative of Chinese culture in my opinion especially nowadays. Because Shan Shui City is the most original design concept generated from the genuinely indigenous culture of China, which is used as the vernacular concept to combine with parametric design approach in following design part in this thesis.

本市海淀区 清华大学建筑学院

吴良镛教授：

我近日读到 7月25日、26日《北京日报》1版、

7月30日《人民日报》2版关于菊儿胡同危旧房改造为“北京的‘楼式四合院’”的报道，心中很激动！这是您领导的中国建筑大创举！我向您致敬！

我近年来一直在想一个问题：能不能把中国的山水诗词、中国古典园林建筑和中国的水画溶合在一起，创立“山水城市”的概念？人离开自然又要返回自然。社会主义的中国，能建造山水城市式的居民区。

如何？请教。

此致

敬礼！

钱学森
1990.7.31

Fig 2.6

The letter written by Qian Xuesen asked the question "why do not we design a 'Shui Shan City' based on the concept extracted from Chinese Shan shui painting, Shan Shui poetry and Chinese garden?" (red underline part)

North West Corner ----- Josef Hoflehner, 2009, Xi'an, China

3.0 PROJECT REVIEW

- The Guangzhou Opera House
- Shanghai Natural History Museum
- Parametric Architecture & Vernacular Architecture

THE GUANGZHOU OPERA HOUSE

Fig 3.1

The Guangzhou Opera House is designed by Zaha Hadia, the dynamic form and the interior space are in consistence.

The Guangzhou Opera House (Fig 3.1), designed by Zaha Hadid, is significant because it is one of the first parametric buildings from the visionary conception to reality. The inspiration drew from the adjacent Pearl River, the project is conceived as pebbles in a stream smoothed by erosion. It was fortunate for Hadid to have a client, the Guangzhou Government, who wanted to make a bold statement and was willing to take the risk building an unprecedented free form building. The central business district, in which the opera house is located, has been filled with newly built skyscrapers and wide boulevards of an international more or less rational style. Despite that there were no imminent traces of a history on that site, Guangzhou is in a unique situation to be the origins of a rich South-Chinese culture. The neighbourhood resulted modern city context that is detached from a cultural-social context. The landscaping of the area, with a few patches of grass and water pools, don't negotiate with the local climatic conditions. Without adequate landscaping and seating facilities the Opera House emphasises the visual impression of form (Fig 3.2), which consists of two separate buildings, both clad in triangulated granite panels with different colors one for grey and one for white. The grey building is the main opera house includes practice rooms and a grand foyer space. The white building houses smaller

Fig 3.2

The vast area without any seating facilities make people be exposed to direct sunlights.

theater for non-opera performance. Unfortunately, the details are less impressive (Fig 3.3), whereby the complex polygonal cladding system fails to match up with the irregular form of building. Subsequently joints cannot be lined up, and panels sometimes do not fit. All of those makes the exterior finish appear not matching the over gesture and the implied quality of parametric design. Architectural critic Nicolai Ouroussoff (2011) points out this as well in his review of project for the New York Time, he attributes the poor quality of construction to the lack of skilled labor and limited construction methods in China. Yet there are examples of parametric projects in China finished with a high standard. Hadid's Galaxy Soho, has achieved a fairly high degree of quality, therefore, this chapter argues that the complex convoluted shapes of the Opera House and the difficulty to translate computer generated form and

Fig 3.3
Poor construction details due to lack of skilled labor and limited construction methods

details into the built form.

As a piece of architecture individually, parametric design create the fluid dynamic form and consistent with the outside, the interior space is also fluid in form. In this perspective, the Guangzhou Opera House is no doubt truly unique and captivating. But as a piece of architecture in a larger urban context, the Guangzhou Opera House

is self-referential and anti-urban which means that it could be deployable anywhere in the world. In other words, this project from Zaha Hadid is free from the parameters of sites, free from the parameters of culture, free from the parameters of tectonics, free from the parameters of the environment. Even though it could not be tell what kind of parameters were get involved in the Guangzhou Opera House. But it is inevitable that the Guangzhou Opera House will be a photogenic and catchy object which also become the archetype of contemporary parametric architecture in China even in the entire world.

The reasons behind are a starchitect that activate the imagination of students and architects, an ambitious and rich client and developer, endless public controversial debate, numerous publications on web pages and in newspapers, magazines, a 'photogenic' form that allows everyone to take catchy, dynamic photographs but simultaneously hides an empty architectural essence, and, eventually a description of an idea that should change at least half of the city, not only the building's surroundings. The Guangzhou Opera House is no doubt the ideal candidate and unfortunately it is not the only one, Galaxy Soho, Wangjin Soho Sino – Steel Tower, Phoenix International Media Centre, are all considered as candidates. What happens about these candidates might be more

like a successful advertising campaign, rather than an intellectual discourse about world-changing craftsmanship, but it really seems that contemporary architecture broke away from reality. It became a collective hallucination, in which media, investors, architects, students and critics exchange not the information or ideas, but empty catchwords and shapes that lead to hollow explanations of their ideas or projects. The generative environments remain only digital and the parameters are chosen selectively. Someone might argue it is an exaggerative trenchant comment about parametric architecture in China, but no one could deny it is true. This scenario in China clearly exposes the confliction between market demand and parametric architecture should supply. The economic value attached to the building is the real goal most of clients and developers in China try to achieve. However, the result is not quite as expected. Galaxy Soho so far is still almost completely empty since the opening ceremony on the 27th October 2012 (Michał Jurgielewicz, 2013.). This is not only due to the constantly rising price making investors lose their interest, but also inflexible offices and dark spaces. The Beijing Cultural Heritage Protection Centre also asserts that the Galaxy Soho has 'caused great damage to the preservation of the old Beijing streetscape, the original urban plan, the traditional hutong and courtyard houses, the landscape formation, and the style

and colour scheme of Beijing's unique vernacular architecture.'

SHANGHAI NATURAL HISTORY MUSEUM

Fig 3.4

Shanghai Natural History Museum, designed by Perkins + Will, is trying to merge some vernacular ideas through parametric architecture.

Shanghai Natural History Museum (Fig 3.4), designed by Perkins + Will, is a quite impressive example trying to do the 'mixture' strategy. The overall shape was inspired by the nautilus shell, the courtyard garden is located on the centre of this shell. It is recognizable for every Chinese to read the cultural references of traditional Chinese gardens in this project. The typical parametric cellular structure is designed for the central wall that actually enclosed this garden (Fig 3.5). The performance of this combination has to be highly appreciated. As Global Design Director Ralph Johnson of Perkins + Will said 'The use of cultural references found in traditional Chinese gardens was key to the design, Through its integration with the site, the building represents the harmony of human and nature and is an abstraction of the basic elements of Chinese art and design.' In other words, the intangible vernacular culture in China could be wisely used by architect, of course, merged with parametric architecture is also promising. However, it might be argued that Shanghai Natural History Museum is shallowly used the parametric pattern covering on the surface of the form. It has to be admitted that the Guangzhou Opera House and Galaxy Soho are revealing a higher quality of parametric design, but lack of the vernacular element make them as alien arrival for China.

Fig 3.5

The public place is designed inspired by traditional Chinese gardens as the top picture shown. The cellular structure enclosed the area is typical example of parametric cellular structure.

PARAMETRIC ARCHITECTURE

&

VERNACULAR ARCHITECTURE

Apparently, most of parametric architecture already had been built in China could be criticized for same interpretation just as the Beijing Cultural Heritage Protection Centre criticized Galaxy Soho. It looks like the parametric architecture means to against 'the original urban plan', the traditional formation, style, materials and every vernacular architectural elements. But there is actually no necessary opposing relationship between parametric architecture and vernacular architecture. Vernacular architecture represents a pure reaction to an individual person's or society's building needs through the most suitable design in terms of typology, materials, color scheme, architectural genre, a spatial language and form which are perfectly adapted to its locale. Moreover, vernacular architecture is changing or adapting over centuries when necessary to variable environments and the nature of family and social growth; it is the time- honoured. Its cultural identity, of course, is clearly merged into the architecture in every facets. In other words, it is a optimization processing naturally and spontaneously happening over time (Fig 3.6). However, in a globalization age, the vernacular architecture has been regarded as backward and has been often ignored by both clients and architects due to the inappropriate architectural values. Essentially, parametric architecture is doing the same optimization process

Fig 3.6

Digrams are indicating that they are approaching the optimized output in different ways and with different cost. For example, parametric architecture consumes less time with digital tools; vernacular architecture costs much more time but better adapted to its locale.

through parameters change. As Chris Yessios (2003), the founder and CEO of the modelling software FormZ claims "Initially, a parametric definition was simply a mathematical formula that required values to be substituted for a few parameters in order to generate variations from within a family of entities. Today it is used to imply that the entity once generated can easily be changed." But in comparison, parametric

design is lower cost in term of capital and time, more flexible and more rational. And this is the real motivation and benefit of parametric design introduced in architecture practice, but not the stunning forms, and shallow ideas. Therefore, why could not the vernacular architectural elements be converted into parameters to drive the parametric design process or design via a mixture of different degrees to achieve harmonious state.

Huangpu River View ----- Josef Hoflehner, 2009, Shanghai, China

4.0 SITE ANALYSIS

- Introduction
- Site Research
- Comparison & Analysis
- Reflection & Conclusion

INTRODUCTION

As mentioned before, entire China is undergoing a dramatic transformation based on brutal economic development. Many issues arises along with the rapid of development as Fig 4.1 trying to express. Yangzhou as my hometown also inevitably is undergoing a rapid urbanization process. There are the reasons why Yangzhou is chosen as the city for thesis study and site for design:

Yangzhou is my hometown, I have lived in Yangzhou for more than 18 years. It means I could be objective to observe and reflect the authentic circumstances of the city. In the meantime, personal experience of living there is also helpful to dig deeper and more.

Yangzhou is considered as one of longest history cities. The urbanization process in Yangzhou has to face more complicated and serious confliction between demolition and preservation. And in Yangzhou, the heritage is much closer to local people than other cities, which make a impact on people's life there.

Compare to those metropolis in China such as Shanghai, Beijing, Guangzhou, Yangzhou as a medium-sized city is more representative for understanding national average level of urbanization.

Fig 4.1

It is a screen shot from a video called Phantom Landscape made by Yang Yongliang, the Shan Shui is fully filled of numerous buildings. And many cranes in the drawing reveals construction is no going to stop.

SITE RESEARCH

Yangzhou is located on the southeast of China, sitting on the northern bank of Yangtze River(a part of the Changjiang River), it borders the provincial capital of Nanjing to the southwest, Huai'an to the north, Yancheng to the northeast, Taizhou to the east, facing Zhenjiang on the southern bank of the river (Fig 4.2). It has approximate 2480 years history according approved characters, which was founded in the Spring and Autumn Period(770 – 476 BC) when it was named Guangling. Until 590 AD, the city began to be called Yangzhou but actually including the entire southeastern China. During the reign of the Yang emperor (604- 617), Yangzhou had became the most important port in the canal transportation system which was built to link Luoyang and Chang'an (now Xi'an). In Tang dynasty (618-907), Yangzhou became the administrative centre for the state's financial apparatus in southern China as well as the head quarters of salt administration due to the significant location in the canal system.

Yangzhou continued to be a flourishing trading centre until the canal system was gradually replaced by the sea transportation. Grain shipments to northern China were increasingly by sea from Shanghai. Whilst the changes in the salt administration also struck at the other base of Yangzhou's traditional prosperity. However, what the prosperity in the history bring to Yangzhou is far more than economic and political value.

In term of architecture, many private gardens, residential communities, and temples are inherited and preserved well, more importantly, they are making an impact on people's life nowadays. As the bottom map in Fig 4.2, all heritage buildings are located in old city area, but new developed city area is more like modern city which is fully filled with high rise buildings as offices, apartments, shopping mall and so on. Two completely different urban developing strategies generate two completely circumstances in one city.

Fig 4.2

COMPARISON

&

ANALYSIS

Fig 4.3
The maps below is provided by Yangzhou City Council.

The map indicates the different land uses which is provided by Yangzhou City Council. The shadow areas in the right map represent new developed city area in Hanjiang district and old city area in Guangling district. According to the map provided by Yangzhou City Council, there is no a notable difference between new development area and old city area in term of programming: both of them are dominated by residential uses (yellow), and some business areas are allocated along the streets.

Fig 4.4 demonstrates another urban pattern. The pictures on the left page are small shops along Dong Guan street, all those buildings are reformed and refined based on the heritage site. The pictures on the right are residential area: a narrow lane on the top (小巷), and a private garden in a house on the

bottom. It is not only area impacted by heritages, fig 4.6 on next pages provides more examples to show how heritages make an impact in old city area.

Fig 4.5

As mentioned before, all heritage buildings are located in old city area, some significant spots are listed below and pointed out on left map (Fig 4.5):

Slender West Lake is a national park in Yangzhou City nowadays. The landscape is well designed to emphasize the natural scenic lake.

Wen Chang Ge (Pavilion of Flourishing Culture) was built during Ming Dynasty, now is considered as a monumental symbol of a long history of Yangzhou city.

Fu Guan and Wei Guan belongs to small scale gardens which are normally reformed for commercial use: shops and restaurants. They provides consumers a vernacular and traditional experience while they are shopping or having a dinner.

Ge Garden and He Garden are the most famous private gardens in Yangzhou city, the former was built in the Ming Dynasty and latter was built in the late Qing Dynasty. Both of them are a heritage private garden and open to the public. The surrounding communities has been influenced. This influence is not only about building forms, detail, materials but also the people activities and relationship between people.

Pictures on the left(Fig 4.6) is showing that it is still dominating to move on foot or by bike in this old city area due to the narrow roads. The pictures above demonstrate activities happened in the weekend such as playing Chinese chess, chatting with others around buildings or doing some exercises in public space. And there is a fact notable shown in the picture: people in the pictures are aged. There are possible reasons: firstly, this generation are grown up in this area and

most of their children or grandchildren are moving out. Secondly, they are possibly the last generation still keep the traditions due to the old city pattern: the connection with history, people in the same community, and vernacular spirit.

Fig 4.7

Fig 4.7 is the picture of Golden Eagle shopping mall, one of largest shopping malls in Hanjiang District, it is separated from residential community by a large park area and street in front. The bottom picture is another residential community under construction near Golden Eagle shopping mall. The high rise buildings are everywhere and being

erected, changing the new developed area's skyline by month. And it is what is exactly happening in every city of China.

Fig 4.8 above are the pictures showing the daily scene on the road, unlike the old city area, there is barely a man walking or riding a bike. The vehicle is the major travelling tool in this urban area. It is not only because standard

of living increase recent years and cars start to enter into every family in China; but also because vehicle is no doubt the most time saving choice for travelling in this urban area.

Gated communities have appeared in China since the 1978 economic reform. Every residential communities in Chinese cities have walled themselves away from their surroundings for security and management. The residential

communities in Yangzhou is no exception just as the picture above shown. The top picture is the gate of a community with the name above it. The bottom picture is the endless wall enclosed the community for isolation.

Fig 4.9 demonstrates usage of green place and public place is incredibly low in weekend. The activities are not happening in open space like the scene in old city area. The interaction between people naturally is killed

before it happens. But unfortunately, it is a microcosm of urban life in the new developed area of Yangzhou.

Fig 4.11

This is the comparison digram derived from observation above.

REFLECTION

&

CONCLUSION

In conclusion, the more active circumstance in old city area of Yangzhou is reasonable, because it is taking advantage of vernacular urban pattern and heritages site left in the area: one key is being highly consistent with Ge Garden, He Garden etc in form, materials, details and so on in order to blend the surrounding buildings into traditional atmosphere. Meanwhile urban pattern is preserved well, unlike the new developed area, modernization process in this area is based on what there used to be: low-rise courtyard houses accessible through a web of narrow alleys. Under these conditions, it is the most efficient for travelling on foot or by bike. The possibility for society interaction is much higher than that in new developed area. So the strategy made this old city area modernized “quietly” and it is not only good for preserve of heritage sites but also for keeping the vernacular manner of local people.

For the new developed area, the circumstance is complete different. The strategy is straightforward because of complete blank land. Therefore the residential use land is organized and separated by the urban network system, and every block is vast (furthermore study on this presents in following chapter). Thus vehicle as the most convenient daily transportation tool is dominating. Besides the vast block decreases the potential social

interaction happening, the gated communities also contribute to the isolation and disconnection. Normally the gated communities comprised of a group identical high rise buildings are designed for population explosion as well as to reduce the cost for property developer. People have no choice to go around it instead of through it. The networks inside of community area are disconnected from the urban network system. It also makes the usage of green space and public space at low level, because there is no social interaction happening attracting people going outside and everyone prefers staying in the car or in the house.

Someone might argue we should design the new developed area as same as the old city area in Yangzhou. As mentioned before, the strategy of old city area has an prerequisite: preserve the heritage sites. But there is no need to do the same work for new developed area, furthermore, it is not economic and efficient to copy the same form, detail and style. In the following chapter, this thesis proposes alternative design solutions for a new residential community to address the problems presented above. The site for design is located on the new developed area(Fig 4.12).

Fig 4.12

Shanghai Haze ----- Josef Hoflehner, 2008, Shanghai, China

5.0 PRELIMINARY DESIGN

- Introduction
- Urban Grid Research
- Chinese Private Garden Research
- Prototype Design

INTRODUCTION

Site research has presented the difference between new developed area and old city area. The problems are apparently related to both urban and building. Therefore it is necessary to explore solutions separately and combine them in the end (Fig 5.1).

In term of urban scale, the isolation and disconnection caused by the vast blocks and gated communities is staying at the surface through observation of transportation tools, people's activities and residential communities. This chapter provides more comparison research on different cities to figure out a solution for design in urban scale. Meanwhile the alternative network system base on Frei Otto's optimized path system is introduced by parametric tool.

For building scale, it is essential to make the green and public space more activated to increase the social interaction. It is not only a challenge to introduce the natural elements into building but also an opportunity to bring back the Shanshui concept. Therefore, in this chapter, it is necessary to study on Chinese private gardens, because the private garden as a precedent case is considered as a sensational architecture to express Shanshui concept.

Fig 5.1

URBAN GRID RESEARCH

Fig 5.2

The data is collected by author.

Fig 5.3

The data is provided by World bank group's report, *East Asia's Changing Urban Landscape*.

This is a straightforward comparison of urban grid between different cities (Fig 5.3). The cities like Turin Paris Barcelona have more than 100 intersections per square kilometer, and New developing area in Beijing, and Pudong in Shanghai only have 14,17 intersections per square kilometer. What is interesting is Hutong in Beijing has 119 intersections per square kilometer. It is no surprise to find out that new area in Beijing and Pudong in Shanghai own the largest number in distance between intersections which are 400 meters and 280 meters. It means these two metropolis of China, the proud results of rapid urbanization and modernization in China, have extremely low walkability, accessibility and connectivity.

Therefore, it forces people to travel by

cars rather than on foot, by bike or by public transportation. This is exactly the same circumstance happening in new city area in Yangzhou. What is worse, the vast scale architecture and gated communities everywhere are continuing to consolidate the isolation and disconnection, because they essentially own its independent routes inside which barely connect with outside network system.

As fig 5.2 shown, it depicts that new developed area in Yangzhou has close figures as that in new city area in Beijing and Pudong in Shanghai, and old city area is more like the Hutong area in Beijing and other European cities. As mentioned before, it is not necessary to copy the whole thing in old city area, but these figures of old city area are

valuable references. Because it means a proper density of urban fabric which is developed and derived from history, culture and vernacular architecture of Yangzhou. In addition, it also generates a proper distance for people, which encourage them to communicate with each other and have more chances for social interaction.

CHINESE PRIVATE GARDEN RESEARCH

Fig 5.4

Chinese private garden growth diagram

COURTYARD

PRIVATE GARDEN

FAMILY GROWTH
DEMAND OF GREEN PLACE INCREASE

There are multiple reasons for a failure of the green space attracting people in new developed area in Yangzhou. But fundamentally the low accessibility, walkability and connectivity set the tone. It allow few people to access a green space nearby easily. In this perspective, it dramatically decreases the number of people intending to spend time there. On the other hand, most people prefer travelling by car rather than by bike and on foot, which

makes it impossible for people to pass by a green space or briefly stay at the green space. It also means that there is a clear boundary between buildings and green spaces. They are not designed to be harmoniously combined with each other. People have to make a choice: comfortable indoor place but without nature or beautiful outdoor place but inconvenient to go to.

The other reason is the green space itself

is not attractive, they are all grassed over for just showing identity of “green space”. In fact, it becomes a general way for developers to achieve the green rate that government asks for. As a result, people are not satisfied with these so called green spaces and nobody is going to spend the time in these spaces.

Chinese private garden has provided many good ideas to address the problems as discussed above. It is not only a sensational approach to combine the building and green spaces but also a intellectual way to express the vernacular ideas: Shanshui.

It is necessary to clarify that the Chinese private garden does not refers to a garden in Chinese style. It is always comprised of garden and buildings, two components are considered as an organic whole. The fig 5.4 depicts how the green spaces are introduced into traditional Chinese courtyard houses. The courtyard is the only option in the begin, which is too small to be designed elaborately. But when the family grows, the demand of green place increase, the garden will add into the house. So the boundary between garden and building becomes blur. They are interlocked with each other, people can experience both indoor and outdoor freely.

Fig 5.5 are listing three famous Chinese private gardens as study cases. Ge Yuan Garden was built on 1818 Qing

Dynasty, Liu Yuan Garden was built on 1798, Qing Dynasty as well. Lion Grove Garden was built on 1342, Yuan Dynasty. These are the roof plans and circulation, they are designed to use the space efficiently, the path will lead the people go to every corner. Unlike the other Chinese architecture, private garden abandons the rule of symmetry and show no apparent spatial hierarchy. Because it creates the “irregularity” to express the real nature in the artificial context of the garden. But this irregularity is entirely and elaborately calculated, like a film, its effect are built via a sequence of different scenes and settings. Architecture elements are also playing the same role as rockery, ponds, plants to compose a scene. so in this perspective, the boundary problem between buildings and green spaces no more exists.

The process of generating forms of every component including rockery, ponds, plants through which “real ” nature could present itself in the artificial context of the garden is the core idea of Shanshui concept. It is not copy and imitate the real nature but call up the same emotional reactions through “artificial” nature.

Fig 5.5

PROTOTYPE DESIGN

Fig 5.5

Experimental models of self-generating occupations and connections on the left. Processes of occupation (taken from Otto, 2011) and connection - path systems on the right (taken from Schaur, 1992).

The prototype is derived from the Frei Otto and Eda Schaur's optimized path system. They presents an experimental model for obtaining minimized detour path systems. Schaur claims that the minimized detour system offers the best balance between the factors below (Schaur,1992, PP. 50-51):

- (1) *The area they occupy;*
- (2) *Maintenance;*
- (3) *Energy required for their use;*
- (4) *Promotion of social interaction.*

In addition, this system is self-organized system, the nature of system drive this form finding process rather than designer. This bottom up approach could ensure the rational of prototype design also could generate the irregularity

of prototype design. Therefore these features of the minimized detour path system indeed are able to address the urban grid problem and provide irregularity.

The following pages will explain how to establish the prototype via digital tool based on wet wool experiment and apply it on the site.

Fig 5.6

The simplified diagram below reveals the bundling process after threads wet is essentially the interactive force among the wool threads. Therefore, it can be digitally simulated this experiments through the use of Kangaroo(plugin-in for Rhino).

1. Individual threads
, then make them wet

2. Attractive forces introduced due
to the water

Fig 5.7

The minimized detour path system is established digitally as below. It is sensitive to response the parameters: the reference points, the interactive forces, which directly influence the density and intersections.

Fig 5.8

The left one depicts the access points as reference points for the minimized detour path system. Then connect each point to every other in order to apply the algorithm of simulation.

Fig 5.9
These different results below is caused by different times of iteration. And the parameters in the functions barely have the meanings in terms of

architecture.

Li River ----- Josef Hoflehner, 2007, Guangxi, China

6.0 DEVELOPED DESIGN

- Introduction
- Optimizing Process
- Typology Study
- Form Finding Process

INTRODUCTION

The prototype is actually simulation of wet wool thread experiment, it does have potential to be applied as network system for the site, but as mentioned before, the algorithm of prototype could keep running and produce countless solutions. And the parameters barely have the meaning in terms of architecture. It all leads to be impossible to find an optimized solution based on parameter and numbers of iteration only.

So it is time to look back the conclusion of urban grid studying: 137 intersections per square kilometer, 72 meters between intersections which is the figure for old city area in Yangzhou. It means a proper density of urban fabric which is developed and derived from history, culture and vernacular architecture of Yangzhou. It also generates a proper distance for people, which encourage them to communicate with each other and have more chances for social interaction. Therefore, setting these figures as criteria to find the optimized solution. After then, evaluation process is needed for the optimized solution through the diagrams.

Meanwhile, the typology study starts from considering how the Chinese residential house evolving from past to present in order to better understand the relationship between indoor space and outdoor space in China. The new typology combining residential houses

and green spaces without a clear boundary is needed to address the problems.

At last, the form inspired by Shuishan concept and Chinese private garden define the final design, and the buildings could play the same role as it used to play in Chinese private garden not just a container of residential function but also a part of natural scenery in the entire new residential community.

OPTIMIZING PROCESS

OLD CITY AREA

As a criteria for the optimizing process

THE OPTIMIZED SOLUTION

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	-----

cates being low activated, and the red indicates being highly activated in contrast. The left diagram is the result of overlapping every

Fig 6.2

The three diagrams on the right side are derived from the path system field diagram. They are generally indicative perspectives. The second one is water running off diagram based on the original diagram, which provides the division from the former three diagrams.

ing the same information underneath but different diagramming logic to generate the design idea from different
ion. The third one is simplifying and organizing the potential blocks in city. The last one is building footprint derived

TYPOLOGY STUDY

CHINESE RESIDENTIAL HOUSE EVOLVING DIAGRAM

PAST

COURTYARD HOUSE

LOW DENSITY

MORE GREEN/PUBLIC SPACE

CLOSE TO NATURE

The diagram on the right clearly reveals that how the Chinese residential house evolving from past to present. It is not only about the growth of height but also about the proportion between indoor residential space and the public/green space. The more indoor residential space means less public/green space and vice versa. It also means they are consuming each other for larger area. Nowadays developers in China always are looking for the larger residential space for larger profit. The public/green space is enclosed by buildings in the courtyard form, and it starts moving out and becoming smaller and smaller.

At same time , the density increases from past to present for the population explosion. but with high rise building, the units are insular. Therefore, neither of them is sufficient.

NOW
 HIGH RISE
 HIGH DENSITY
 LESS GREEN/PUBLIC SPACE
 FAR AWAY FROM NATURE

FORM FINDING PROCESS

105M

NORTH ELEVATION

0M

105M

EAST ELEVATION

0M

105M

WEST ELEVATION

0M

SOUTH ELEVATION

Fig 6.3

The diagram shown below is two different residential buildings with different methods of introduced natural elements, circulation and density.

Xitang ----- Josef Hoflehner, 2006, Zhejiang, China

7.0 CONCLUSION

CONCLUSION

In conclusion, China is now considered as the one of largest developing countries, whereby globalization is recreating rapidly the built environment matching a uniform international parametricism that reflects western or international design ideologies without responding to local cultures and traditions. The country's character of historic inheritance is being erased by the fast and un-reflected developments of its cities. Issues found in China can be transferred to other cultures alike. Capital driven and rapid developments often consist of the same ideas that is applied everywhere. For the world's architects, China has become the playground for an architectural expression that lacks of local and inherited cultural connections. Yet parametric designing offers a unique opportunity to overcome these forces and to intersect with Chinese vernacular cultural expressions to develop an architecture that embraces local identities of its cities and cultures. Parametric architecture needs to be understood and require acceptance rather than protesting especially in China. What parametric architecture really benefits us is not stunning forms or monumental geometry, it is the new design approach it generate. It is changing the traditional approach of architectural design: expressing design intentions with parameters. In addition to thinking about what they are designing, architects working with parametric models must also think

about the logical sequence of formulas, parameters, and relationships that explain how to create their designs (Aish and Woodbury 2005.) which would be a good chance to introduce the vernacular architecture in.

Furthermore, the situation, new city area developing model happened in Yangzhou, is generally happening everywhere in China. It is not only a good chance for China to expend and consolidate urbanization but also a opportunity for architects to figure out how to bring back the Chinese vernacular gene in contemporary Chinese city at same time to avoid and resolve the issues discussed above. Meantime, for the old city area like Yangzhou's, preservation of heritages is not only way to establish the connection to the history, but also it provides many clues for new city areas development in vernacular way in order to keep the identity of culture in an entire new land.

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